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ABSTRACT

This packet of six learning modules on safety is one of eight such packets developed for apprenticeship training for low voltage alarm. Introductory materials are a complete listing of all available modules and a supplementary reference list. Each module contains some or all of these components: goal, performance indicators, study guide (a check list of steps the student should complete), a vocabulary list, an introduction, information sheets, assignment sheet, job sheet, self-assessment, self-assessment answers, post-assessment, instructor post-assessment answers, and a list of supplementary references. Supplementary reference material may be provided. The six training modules cover general safety, hand tool safety, power tool safety, fire safety, hygiene and safety, and safety and electricity. (YLB)

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APPRENTICESHIP

LOW VOLTAGE ALARM

RELATED
TRAINING MODULES

6.1 - 6.6 SAFETY

CE 040965

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STATEMENT OF DEVELOPMENT

This project was developed and produced under a sub-contract for the Oregon Department of Education by Lane Community College, Apprenticeship Division, Eugene, Oregon, 1984.

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APPRENTICESHIP

LOW VOLTAGE ALARM
RELATED TRAINING MODULES

0.1 History of Alarms

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28.9 Work Habits and Attitudes
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29.2 Blueprint Reading/Working Drawings
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29.4 Sketching
29.5 Machine and Welding Symbols

LOW VOLTAGE ALARM

SUPPLEMENTARY REFERENCE MATERIAL

Intrusion Detection Systems: Principles of Operation and Application

Author: Robert L. Barnard
Edition: 1981

Understanding and Servicing Alarm Systems

Author: H. William Trimmer
Edition: 1981

In the event additional copies are needed, they may be purchased through:

Butterworth Publishers
10 Tower Office Park
Woburg, Ma. 01801

RECOMMENDATIONS FOR USING TRAINING MODULES

The following pages list modules and their corresponding numbers for this particular apprenticeship trade. As related training classroom hours vary for different reasons throughout the state, we recommend that the individual apprenticeship committees divide the total packets to fit their individual class schedules.

There are over 130 modules available. Apprentices can complete the whole set by the end of their indentured apprenticeships. Some apprentices may already have knowledge and skills that are covered in particular modules. In those cases, perhaps credit could be granted for those subjects, allowing apprentcies to advance to the remaining modules.

We suggest the the apprenticeship instructors assign the modules in numerical order to make this learning tool most effective.

6.1

GENERAL SAFETY

Goal:

The apprentice will be able to describe general safety procedures.

Performance Indicators:

1. Describe safety awareness.
2. Describe causes of accidents.
3. Describe unsafe acts.
4. Describe safety planning.

Study Guide

This study guide is to be used by the student as a "blueprint" to successfully complete this module. Please complete all of the following steps, and check them off as you complete them.

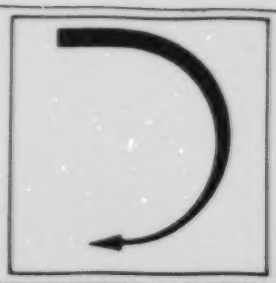
1. ____ Familiarize yourself with the Goal and Performance Indicators of this module. This will give you an overall view of what the module contains and what you'll have to do to complete it.

2. ____ Study the Information section thoroughly. This will provide you with the knowledge necessary to pass the exam.

3. ____ Take the Self Assessment Exam which follows the Information section. The exam is designed to determine whether you have learned enough from the Information section to sucessfully complete the Post Assessment exam. You may refer to the Information section for assistance, but if you have too much trouble on the Self Assessment portion, you should re-study the Information section before going to step 4. Compare your Self Assessment answers with those on the Self Assessment Answer Sheet following the Self Assessment exam.

4. ____ Complete the Post Assessment Exam and turn it in to your instructor for grading. It is recommended that you score 90% or better on the Post Assessment before going on to the next module.

Introduction



GENERAL SAFETY

THE IMPORTANCE OF SAFETY

Employees owe it to themselves, their families, their co-workers, and their employers to work in the safest manner. Unless safety principles and practices are faithfully observed every day, the time and effort an apprentice puts forth in learning a trade could become a tragic waste. Taking the time now to learn about job safety can mean the difference between life and death or between living a normal, productive life and having to struggle for a decent living as a result of a physical handicap.

By their very nature, occupations within the construction industry are extremely hazardous, and an employer or an employee who lacks concern for on-the-job safety contributes toward an increased possibility of accident or death on the job.

This topic and those that follow on safety are designed to help apprentices become aware of some of the hazards of the trade, to help them become safety minded, and to enable them to use their reasoning powers to recognize dangerous situations.

Information

For the past several years, the number of employees killed has averaged 14,200 a year. From 1960 through 1970 there were over 150,000 fatalities. In 1972, more than 50 million employee-days were lost because of disabling injuries, and the known cost of accidents--not counting property damage--was over $11.5 billion. Unknown costs, resulting directly from accidents but not recorded, or not possible to record, are several times higher. These figures do not include most of the deaths and disabling illnesses from occupational disease. Most of these were not recorded before enactment of the Williams-Steiger (OSHA) Act of 1970.

Recently, employers, unions, employees, and various government agencies have seen the need for developing effective programs to improve occupational safety and health. The importance of keeping employees safe and healthy has achieved such wide-spread recognition that a broad and detailed national program finally has emerged.

Everyone is beginning to realize there is an obligation to protect individuals from on-the-job accidents and illnesses.

While more than 50 million employee days were lost in 1972, it's obvious that great losses in employee productivity, not to mention the 14,000 employees killed, were recorded. For example, it would take 188,000 men working for one year, five days a week, eight hours a day, with no vacations or time off, to make up for this lost time. These figures point out that too many employees are disabled form industrial accidents. However, many disabling injuries can be prevented.

It is impossible to put a dollar value on the tremendous wasted ability and contribution lost to society because of the death or disability of a fellow human.

CAUSES OF ACCIDENTS

An accident is an unplanned and unforeseen occurence that interferes with or interrupts the orderly progress of an activity. Although by this definition

accidents do not necessarily involve injury or death, in fact they all too often do. Accidents that do occur should be analyzed to determine why and how they occurred and to determine what steps should be taken to ensure that similar accidents do not occur again. Accidents are caused for the most part by unsafe conditions, unsafe acts, or some combination of these two hazards.

Unsafe conditions on the job site may be present in the form of equipment that is poorly designed or constructed, improperly installed, or badly maintained. Unguarded equipment, defective or wrong hand tools, poor housekeeping, and inadequate lighting are common factors that make for unsafe working conditions.

UNSAFE ACTS

Unsafe acts are violations of safe working practices. Wearing loose-fitting clothing on the job, operating machinery without the required guards or improperly throwing instead of carrying materials, lifting or carrying with the back bent, and engaging in horseplay on the job are all examples of unsafe acts.

Unsafe conditions and unsafe acts are both threats to the worker's safety, but the majority of industrial accidents are caused by a combination of these hazards. A wheelbarrow with cracked or loose handles (unsafe condition) may not play a part in an accident until a worker attempts to move a heavy, unbalanced load in it (unsafe act). A power saw with an unguarded blade is not likely in itself to cause an accident, but a severe injury can result if a worker disregards the unsafe condition of the machine and as a result gets his hand in the way of the blade.

PREJOB SAFETY PLANNING

Although a great deal of time and money have been spent by safety-oriented organizations to improve accident-prevention efforts on the job site, prejob planning continues to be of the utmost importance in providing for the safety of those involved with a construction project. This planning is a cooperative effort and demands the participation of the contractor, the union representative, and the workers. During the prejob planning, an attempt is made to establish rules for safety on the particular project, to anticipate problems that could arise, and to determine appropriate methods for protecting the persons involved with the job and the job site.

In the decade of the 60's, a sharp increase of job related accidents occurred (29%). A wider use of new chemicals and hazardous materials created a greater source of unsafe conditions. Labor's concern for a safe workplace pushed for passage of legislation and in 1970 the Williams-Steiger bill was passed. You know it as OHSA, the Occupational Safety and Health Bill of 1970.

THE WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

In passing the Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA), the federal government declared safety on the job to be everyones responsibility. The purpose of OSHA, which became effective in 1971, is to preserve human resources and to ensure so far as possible that every worker in the nation will have safe and healthful working conditions. This law applies to all states and U.S. territories, but it provides that the states may develop their own plans for meeting the requirements of the law.

RESPONSIBILITY OF EMPLOYERS

The Williams-Steiger Act requires that every employer furnish his employees a place of employment that is free from recognized hazards that might cause serious injury or death. The act further requires that employers comply with the specific safety and health standards issued by the U.S. Department of Labor.

RESPONSIBILITY OF EMPLOYEES

In accordance with the provisions of the Williams-Steiger Act, all employees must comply with safety and health standards, rules, regulations, and orders issued under the act and applicable to their personal conduct.

ADMINISTRATION OF THE WILLIAMS-STEIGER ACT

The administration and enforcement of OSHA are vested primarily in the Secretary of Labor and the New Occupational Safety and Health Review Commission. The basic purpose of the Act is "to assure, as far as possible, every working man and woman in the nation safe and healthful working conditions and to preserve our human resources." The "safe and healthful working conditions" will be assured by authorizing enforcement of the standards developed under the Act. Assisting and encouraging the states in their efforts to assure safe and healthful working conditions and providing for research, information, education, and training in the field of occupational safety and health are also intents of the Act.

7

OSHA covers about 60,000,000 people in 5,000,000 workplaces; excludes Federal employees, State and political subdivisions thereof and certain waterfront workers.

APPRENTICESHIP AND SAFETY

A major goal of all apprenticeship programs is to provide the apprentice with the knowledge and skills needed to work safely in his or her trade. Much time, effort, and money will be devoted to making an apprentice a skilled craftworker, all of which will be wasted if an industrial accident cuts short the apprentice's career and perhaps, life.

Apprentices are expected to learn how to work safely; to study the laws governing safety; to understand the principles upon which safe work practices are based; and to conduct themselves at all times with due consideration for their own safety and that of their co-workers.

The apprentice should keep in mind that accidents do not just happen. Accidents are caused by people, and they happen most often to people who fail to work in a safe manner.

VOCABULARY

Terms and Definitions

A. OSHAct--An abbreviation for the Occupational Safety and Health Act of 1970. The Act provides for minimum safety and health standards for working conditions. It is a Federal Act of Congress.

B. OSHA--An abbreviation for the Occupational Safety and Health Administration. OSHA is part of the United States Department of Labor and its main duties are to:

1. Encourage employers and employees to reduce hazards in their workplaces.
2. Establish responsibilities and rights of employers and employees.
3. Encourage new safety and health programs.
4. Establish record keeping procedures to keep track of injuries and illnesses that happen on/or because of the job.
5. Develop standards and enforce them.
6. Encourage the states to establish safety and health programs.

C. Standards--These are the rules that are set up by OSHA to provide minimum assurance of on-the-job safety. We will be concerned mainly with construction standards. There are two types of standards:

1. Horizontal standards - those applying to all industries.
2. Vertical standards - those applying to one special industry.

D. Variance--This is an exemption for an employer from a particular standard. There are several types of variances:

1. Temporary - when a standard cannot be complied with so other arrangements are made for the time being.
2. Permanent - when a means different from the standard provides adequate safety and health conditions.
3. Experimental - when testing new methods of safety.
4. Other - when there is a national emergency situation.

E. Accident--An unplanned, uncontrolled event which results in personal injury or the chance of personal injury. Accidents cost the U.S. at least $47 billion a year. Of this, $16 billion is due to accidents at work. Work accidents kill more than 12,000 people and cause over 2,000,000 disabling injuries per year in the U.S.

F. Hazard--Something that is potentially dangerous and if not corrected could cause an accident.

G. Contractor--An employer in construction. There are two types:

1. Prime or general contractor - the contractor in charge of the entire construction project and all of its phases. He or she is responsible for the overall safety and health of everyone working.

2. Sub-contractor - a contractor who works for the prime or general contractor and is responsible for some phase of the project such as pluming or painting. Each sub-contractor is responsible for the safety and health of his/her own employees.

H. Safety Director--The person responsible for putting a good safety program to work and keeping it running effectively on a company-wide basis. In large companies there may be a full-time safety director, while in small companies the superintendent or the contractor may act as the safety director along with his or her other duties.

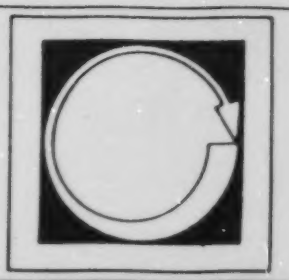
I. Project Superintendent--The person in charge of the entire project, usually reporting to the prime contractor. This person is responsible for putting the safety program to work on the project and making sure the workers follow it.

J. Safety Supervisor--On large projects there may be a full-time person who is assigned by the superintendent to run the safety program, including inspections, investigations, and record keeping.

K. Foreman--The person in charge of a small group of employees. He or she is usually very experienced in her or his trade.

L. Employee--Anyone who works for a contractor or is working on the job site. (TM 1 - 1)

Self Assessment



Determine the correct word(s) for each statement and fill in the blanks.

1. Accidents are caused for the most part by unsafe _____, unsafe _____, or a combination of these hazards.

2. In passing the Williams-Steiger Occupational Safety and Health Act of 1970, the federal government declared that on-the-job safety is the responsibility of _____.

3. The responsibility for administering the Williams-Steiger Act rests with the Secretary of _____.

4. Anyone known to be under the influence of _____ _____ should not be permitted on the job while in that condition.

5. Employees should be alert to see that all guards and other protective devices are in their proper places and adjusted, and they should report any deficiencies to the _____ or _____.

6. Repairs or adjustments to machinery should not be made while the equipment is in _____.

7. A worker whose regular duties do not include operating machinery or equipment should not attempt to do so without special _____.

8. An accident is an _____ and _____ occurrence.

Self Assessment Answers

1. conditions, acts
2. everyone
3. labor
4. intoxicants, drugs
5. foreman, safety supervisor
6. motion
7. permission
8. unplanned, unforeseen

Post Assessment

Decide which of the four answers is correct, or most nearly correct; write the corresponding letter in the blanks at the left of each question.

1. ____ Provisions of the Williams-Steiger Occupational Safety and Health Act of 1970 require that employers comply with safety and health standards issued by the

   a. U.S. Senate
   b. Division of Industrial Safety
   c. U.S. Department of Labor
   d. none of the above

2. ____ Workmen's compensation laws havebeen passed so that workers injured on the job may receive benefit payments

   a. only if the injury was the employer's fault
   b. only if the injury was the employee's fault
   c. if insured through an authorized insurance carrier
   d. in the case of any industrial injury

3. ____ In the lifting of loads, the weight should be carried mostly by the muscles in the

   a. legs
   b. back
   c. arms
   d. abdomen

4. ____ A good program of accident control must include

   a. offering rehabilitation training to injured workers
   b. firing employees who have accidents
   c. correcting unsafe working conditions and practices
   d. putting up safety posters

5. ____ Which of the following is an unsafe act?

   a. sawdust on a stairwell
   b. a ladder with a broken rung
   c. wearing loose-fitting clothing on the job
   d. poor housekeeping

6. ____ OSHA is a result of

   a. expanding federal government
   b. a decision by construction foremen
   c. the safety and health review committee
   d. labor's concern for a safe workplace

7. ____ During a typical year, in the past few years, the number of employees killed was near

   a. 200
   b. 750
   c. 12,000
   d. 100,000

8. ____ Which of the following is not a variance?

   a. temporary
   b. horizontal
   c. experimental
   d. permanent

Instructor Post Assessment Answers

1. d
2. d
3. a
4. c
5. c
6. d
7. c
8. b

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6.2

HAND TOOL SAFETY

Goal:

The apprentice will be able to describe safety practices for the use of hand tools.

Performance Indicators:

1. Describe safe practices for use of common hand tools.

Study Guide

This study guide is to be used by the student as a "blueprint" to sucessfully complete this module. Please complete all of the following steps, and cneck them off as you complete them.

1. ____ Familiarize yourself with the Goal and Performance Indicators of this module. This will give you an overall view of what the module contains and what you'll have to do to complete it.

2. ____ Study the Information section thoroughly. This will provide you with the knowlege necessary to pass the exam.

3. ____ As stated in the Performance Indicators on the cover sheet of this module, you may be examined in one of two ways: 1) by taking the Self Assessment and Post Assessment exams or 2) by completing the Assignment as explained on the Assignment sheet.

   a. ____ Complete the Assignment; your instructor will evaluate your performance.

   or

   b. ____ Take the Self Assessment exam which follows the Assignment page. The exam is designed to determine whether you have learned enough from the Information section to successfully complete the Post Assessment exam. You may refer to the Information section for assistance, but if you have too much trouble with the Self Assessment, you should re-study the Information section before going on to the next step. Compare your Self Assessment answers with those on the Self Assessment answer sheet which follows the exam.

   c. ____ Complete the Post Assessment exam and turn it in to your instructor for grading. It is recommended that you score 90% or better on the Post Assessment exam before going to the next module.

Information

This module, "Occupational Safety - Hand Tool Safety," covers the safety procedures for properly handling and maintaining the most common hand-powered tools formed in the most common work sites. Since the use of tools enables workers to carry out the most important functions of their jobs, each worker must know how to use his or her tools as safely and as efficiently as possible. Obviously, all tools should be kept clean and free of grease or other substances which might affect the grip of the worker or might impair the tools' efficiency. Likewise, tools should not be thrown. In addition to possible worker injury, the tool might be damaged, as well.

This and the following pages contain specific rules for good safety practice. The tools have been grouped into categories for easy reference.

A. HAMMER SAFETY: claw, ball peen, blacksmith's, bricklayer's, setting, riveting, engineer's, stone sledge, mash, and upholsterer's.

1. Choose the correct type and size hammer for the job.
2. The hammer face should be about 3/8" larger in diameter than the object being struck.
3. Never strike two hammer faces together; the faces may chip off.
4. Strike the object squarely and flatly to prevent slipping or denting.
5. If the tool's handle is damaged replace the handle.
6. If the hammer face is damaged or worn out replace the entire hammer.
7. Use a sledge to drive hardened cut and masonry nails, not a claw or bricklayer's hammer. This can damage the faces of the latter two and may cause dangerous flying pieces.
8. Do not use hammers on wooden or plastic handled chisels. Hammers will ruin these handles and may injure hands.
9. Do not pound with the cheek (side) of the hammer. It can too easily slip off and also will damage the handle.

B. MALLET SAFETY: wood, plastic, rubber, rawhide, and nonferrous hammers such as lead, copper, aluminum, and brass.

1. Never use mallets for pounding on sharp objects or for driving nails. This will damage the soft heads.
2. Use mallets to pound on wood or plastic handled chisels to prevent damaging the chisels.
3. Do not use a mallet if the handle is loose, the head may fly off.

C. STRUCK TOOL SAFETY: cold chisels, all-steel wood chisels, drift punches and pins, star drills, blacksmith's punches, nail sets, wedges, brick sets and nail pullers.

1. Be sure struck tools are ground at the proper angles, are sharp and have no burns.
2. Remove mushroomed heads and properly dress the struck face to prevent flying pieces.
3. Replace worn out, cracked, or bent struck tools to prevent injuries.
4. Choose the correct struck tool for the job.
5. Hold the struck tools steady, but with a relaxed grip, so fingers or hands will not be hit. Use pliers or another tool if there is a hand injury hazard.
6. Tools being struck by other workers should be held with tongs.
7. Protect sharp edges when tools are stored, to prevent damaging them or cutting your hands or fingers.
8. Use a sledge, not a bricklayer's hammer, when hitting a brick set to prevent chipping the bricklayer's hammer face.

D. SCREWDRIVER SAFETY: regular, Phillips, Reed and Prince, and electrician's or cabinet in all their shapes and sizes.

1. Select the correct screwdriver for the job with the correct tip style and size, the correct length and shank, the correct handle size, smaller diameter for more speed, larger for more torque.
2. Never pound on a screwdriver. This will ruin the handle, damage the tip, and bend or break the shank.
3. Do not hold the screw with your hand while driving it, drill or punch a pilot hole to prevent hand or finger injuries.
4. Keep hands and fingers out from under the screwdriver to prevent gashes if it slips.
5. Screwdrivers should not be used as pry bars; this will bend or break the

shank and damage the tip.

6. Never use pliers to help turn a screwdriver, the job teeth will ruin the shank or handle.
7. Use an appropriate wrench only on heavy-duty, square-shanked screwdrivers.
8. Use a screw-holding clip or magnetized screwdriver to start screws in awkward places and to avoid hand or finger injury.
9. Use non-sparking screwdrivers, usually made of beryllium copper, when working near explosive vapors.
10. Use only properly insulated screwdrivers when working on electrical devices.
11. Do not use a screwdriver for electrical testing, this will burn or blast a piece out of it.
12. Do not use a screwdriver for stirring paint, varnish, or other materials that will leave a coating on it.

E. WRENCH SAFETY: open-end, box, socket, adjustable, pipe, monkey, chain, spanner, tee, torque, and Allen.

1. Select the right type of wrench for the job. Box and socket are usually the safest.
2. Select the correct size wrench for the job, considering fit and leverage needed. A snug fit is necessary. Don't use cheater bars as the force of the additional leverage will exceed what the wrench handle was designed to withstand.
3. Pull on adjustable wrenches, putting the force on the fixed jaw.
4. Be sure the wrench fits squarely on the object and is not tilted. This will help prevent slipping off or damage to the wrench and object.
5. Be sure your footing and your stance is adequate to prevent falling if something should let loose unexpectedly. Brace yourself if necessary.
6. Use a straight handle rather than an offset if possible, as there is less chance of slipping.
7. Never pound with a wrench.
8. Use penetrating oil on a frozen object first. If this does not loosen it, use a heavy-duty wrench that has a striking face (made to hit with a hammer).

F. PLIERS SAFETY: regular, slip-joint, pump, long nose, needle nose, side cutters, lineman's, crimpers, hose clamp, wire stripper and glass cutters.

1. Select the correct size and type for the job.
2. Never use a cheater on pliers as it can bend, break, and ruin them.
3. Do not expose pliers to excessive heat as it will draw the temper out.

4. When cutting, cut at right angles to the wire. This puts the least strain on the pliers.
5. Do not bend the wire back and forth against the cutting edges as it may damage the edges or spring the pliers.
6. When cutting, point the open side down so the cut end will not fly out at someone.
7. Put a drop of oil on the pliers joint to lengthen its life and allow for easier operation.
8. Use only pliers with high dielectric insulation (not just plastic-dipped ones) when working on electrical devices to prevent shocks or electrocution.
9. Keep jaw teeth or knurls clean to avoid slips and damage to material surface.
10. Never use pliers as a hammer.

G. VISE SAFETY: utility, machinist's, woodworker's, pipe and drill press.
1. When working on an object held in a vise, work as close to the vise as possible. This will help eliminate vibrations and chances for slipping.
2. Clamp objects in the middle of the jaw to prevent uneven strains on the vise.
3. Never use a cheater on a vise handle. This will bend the handle or ruin the screw.
4. Use a vise of adequate size. It is easy to ruin a vise by overloading it.
5. Be sure the vise is securely fastened to prevent it from falling off. Use all bolt holes and proper sized bolts.
6. Do not pound on vise jaws. They are hardened and may chip or crack.
7. Support the far end of long work to avoid putting excessive strain on the vise.
8. Repair or replace a damaged vise before using it.

H. CLAMPING TOOL SAFETY: bar, pipe, miter, spring, hand screw, "C", welder's, bank, and vise grips.
1. Select the correct size and type of clamp.
2. Keep all moving parts clean and lightly oiled to provide easy operation.
3. Do not over-tighten clamps and never use a cheater. This will bend, break, or ruin the threads.
4. Do not use clamps to secure scaffolding. If they are bumped they could let loose.
5. Never use clamps for hoisting materials. Use only approved devices.

I. SNIPS SAFETY: tin, aviation, combination, compound, lever, and shears.

1. Select the correct size and type snips for the job.
2. Keep snips sharp.
3. Do not cut wire with snips, it will damage the cutting edges. Use only on non-hardened sheet metal.
4. Use only hand pressure on the handles, never a hammer or your foot. This could spring the hinge.
5. Protect the edges and points of snips when stored to prevent injury and damage.
6. Wear gloves when cutting with snips.

J. SAW SAFETY: hand saws, miter box, keyhole, compass, hack, back, dovetail, and coping.

1. Select the correct type and size saw for the job.
2. Keep saws sharp and set to insure good cutting.
3. Protect the points from being damaged by checking for nails, bolts or grit before sawing.
4. Use a saw-horse or bench, not your knee or leg to hold material when sawing.
5. Make sure saw handle is in good condition and tight.
6. Be aware of hand, finger, and leg position when sawing to prevent personal injury.
7. Wear gloves when sawing metal to prevent being cut by sharp cuttings.
8. Hacksaw teeth should point away from the handle and saw strokes directed away from yourself.

K. FILE AND RASP SAFETY: rough, coarse, bastard, second-cut, smooth and dea[illegible] smooth metal files, cabinet files, wood rasps, other surform tools.

1. Select the proper type and size file for the job.
2. Do not confuse wood and metal files and rasps. Filing metal with a wood file or rasp will ruin it.
3. Cut on the forward stroke.
4. Clean files often while using to prevent slipping and to insure good cutting.
5. All files must have handles of proper size to prevent hand wounds.
6. Clamp objects to be filed securely to prevent filing your hand or fingers.
7. Never use files or rasps as pry bars, they are very hard and brittle and will snap, besides damaging the teeth.

Assignment

Select any two of the following three assignments to complete instead of taking the Self Assessment and Post Assessment exams.

1. Carry your tool box, kit or pouch to your instructor and demonstrate and tell him or her the proper use, the proper maintenance and the proper selection (what the tool is used for, as well as what it is not used for) for every tool you have. Explain the characteristics of each and point out any potential safety hazards which may exist on each tool.

2. Have your instructor improperly select and/or demonstrate the use of at least one tool from at least seven of the tool categories described in the Information section, while you point out what's wrong with the selection and/or use of each.

3. In your instructor's presence, compare your tools (or your employer's tools if you have access to them) with new tools of similar make, and describe any flaws, damage or improper maintenance which might make your tools unsafe.

Self Assessment

Select the answer which best completes the statement. Write the answer in the blank to the left of each statement.

1. ____ Hand tools should always:
   a. have a layer of grease to prevent rust during winter work
   b. have a layer of oil to prevent rust during winter work
   c. be kept clean of grease or oil at all times
   d. be covered with graphite during the winter

2. ____ The hammer face should be how much larger in diameter than the object being struck?
   a. 3/8"
   b. 5/8"
   c. 1" or more
   d. 1/16" only

3. ____ If a mallet handle is broken, you should always:
   a. tape the handle with non-ferrous tape
   b. glue and splice the handle
   c. heat the handle
   d. replace the handle

4. ____ The following is an example of a struck tool:
   a. star drill
   b. cresent wrench
   c. screwdriver
   d. needle nose pliers

5. ____ Tools being struck by others should be held with:
   a. gloves
   b. tongs
   c. cheater bars
   d. hoists

6. ____ On which type of screwdriver should a wrench be used?
   a. heavy-duty, square-shank
   b. star shanked titanium
   c. Phillips light weight
   d. none of the above

7. ____ Proper wrench safety always includes:
   a. oiling the handle
   b. tilting the wrench at an angle
   c. using an offset handle whenever possible
   d. using penetrating oil on frozen objects

8. ____ What type of cheater should be used with pliers?
   a. non-ferrous metal
   b. wood
   c. none
   d. spring steel

9. ____ When using a vise, objects should be clamped:
   a. at the near end of the jaw
   b. at the middle of the jaw
   c. wherever you want
   d. at the far end of the jaw

10. ____ Clamps should be:
   a. stored in a pile
   b. used for hoisting
   c. used for securing scaffolding
   d. tightened without the use of a cheater

Self Assessment Answers

1. c
2. a
3. d
4. a
5. b
6. a
7. d
8. c
9. b
10. d

Post Assessment

Select the answer which best completes the statement. Write your answer in the blank at the left of the statement.

1. ____ Snips may be used to cut:
   a. wire
   b. non-hardened sheet metal
   c. all lead alloys
   d. hardened sheet metal

2. ____ Hacksaw teeth should be:
   a. pointed toward your body
   b. pointed away from your body
   c. bent at both ends
   d. heated before cutting

3. ____ One characteristic of a file or rasp is it's:
   a. brittle
   b. soft
   c. springy
   d. silver coated

4. ____ When working on or near electrical devices, use only pliers with:
   a. high dielectric insulation
   b. low dielectric insulation
   c. circuit breakers
   d. plastic handles, shanks, tips and barrels

5. ____ A cheater bar provides for:
   a. more leverage
   b. less leverage
   c. less foot-pounds-per-square-inch
   d. C-clamps

6. ____ Wrenches should always be:
   a. pulled toward your body
   b. pushed away from your body
   c. owned by the contractor
   d. silver-plated

7. ____ Struck tools with mushroomed heads should be:
   a. repaired
   b. used as often as possible
   c. used in conjunction with a sledge hammer
   d. coated with plastic

8. ____ When working near explosive vapors, screwdrivers should be:
   a. made of beryllium copper
   b. made of non-ferrous metals
   c. stored in dry ice prior to use
   d. steel-coated

9. ____ When moving about the job site, tools should be:
   a. tossed
   b. thrown
   c. carried
   d. coated in plastic

10. ____ Wood rasps and files should always be:
   a. used on steel
   b. sharpened
   c. rubber-tipped
   d. clamped the object to be filed

Instructor Post Assessment Answers

1. b
2. b
c. a
4. a
5. a
6. a
7. a
8. a
9. c
10. d

6.3

POWER TOOL SAFETY

Goal:

The apprentice will be able to describe safe practices in the use of power tools.

Performance Indicators:

1. Describe safety with electric power tools.
2. Describe safety with pneumatic power tools.
3. Describe safety with hydraulic power tools.
4. Describe safety with power actuated power tools.
5. Describe safety with air compressors.

Study Guide

This study guide is to be used by the student as a "blueprint" to successfully complete this module. Please complete all of the following steps, and check them off as you complete them.

1. ____ Familiarize yourself with the Goals and Performance Indicators of this module. This will give you an overall view of what the module contains and what you'll have to do to complete it.

2. ____ Study the Information section thoroughly. This will provide you with the knowledge necessary to pass the exams.

3. ____ Complete the Assignment as instructed on the Assignment page. The Assignment is intended not only to make you better aware of the principles discussed in the Information section, but it is intended to be part of the requirement for successfully completing the module.

4. ____ Take the Self-Assessment Exam which follows the Assignment page. The exam is designed to determine whether you have learned enough from the Information section and your assignment to successfully complete the Post Assessment exam.

   You may refer to the Information section for assistance, but if you have too much trouble with the Self Assessment portion, you should re-study the Information section before going on to step 5. Compare your Self Assessment answers with those on the Self Assessment answer sheet immediately following the Self Assessment exam.

5. ____ Complete the Post Assessment exam and turn it in to your instructor for grading. It is recommended that you score 90% or better on the Post Assessment before going on to the next module.

Information

This module covers safety procedures for the most commonly-used electric, pneumatic, hydraulic and powder-actuated tools used in and around the construction industry. Many of the rules for operating these tools--as for the operation of hand tools--require only common sense. For example, every worker should know the following: electric tools must have grounding wires or insulated cases to prevent shock; electrical cords must be examined prior to use for insulation or prong damage; proper cord sizes should be used to prevent overheating and fires; plugs should be removed from receptacles carefully to avoid wire damage; switches should be in good operating condition and should be in "off" position before the cord is plugged in; adjust and clean power tools only when the tool is unplugged, and be cautious when plugging in a power cord for another worker.

ELECTRIC

PORTABLE CIRCULAR SAW SAFETY

1. Must be equipped with a fixed guard over the upper half of the blade and a working movable guard over the lower half.
2. Saw blade should clear the stock being cut by no more than 1/8 inch.
3. Use the recommended blade, the proper size, in good condition, and installed correctly.
4. Never block or tie the guard back.
5. Allow the saw to cut without forcing.
6. Check material to be cut for nails, grit, or any material that may interfere with cutting.
7. Always check for the lower guard return before putting the saw down.
8. Adequately support the material to be cut to prevent binding.
9. Allow the saw blade to come to full speed before cutting to prevent overloading and possible kickbacks.
10. Hold the saw firmly, do not allow it to pull out of your hands.
11. Saw in the forward motion only, never backwards.

12. Clean sawdust from around the movable guard often and before using to insure it works properly.
13. Do not over-reach.
14. Never try to cut a curve or other than in a straight line with a portable circular saw.

RECIPROCATING HAND SAWS

1. Select the proper blade for the material used and the cut to be made.
2. Hold the saw firmly.
3. When making a plunge cut, feed the blade in slowly with the base of the saw setting on the material.
4. Hold the base against the material being cut.

POWER HACKSAW SAFETY

1. Securely clamp stock to be sawed.
2. Turn the saw on and lower the blade on to the stock slowly.
3. Allow the saw to cut at its own rate.
4. Support long stock to prevent buckling.
5. Use the correct blade; make sure it is sharp, and mounted to cut on the power stroke. Use coolant if necessary.
6. Metal may be hot and have a sharp burr after being hacksawed.
7. Set blade tension at manufacturer's recommendation.

PNEUMATIC TOOL SAFETY

1. Pneumatic tool hoses must be secured to prevent accidental disconnection.
2. Compressed air can be used for cleaning only if pressure is less than 30 pounds per square inch (PSI) and it is used with an effective chip guard.
3. Any pneumatic hose over 1/2-inch in diameter must have a safety valve at the source that reduces pressure if the hose fails.
4. Couplings between hoses must have a safety connection in case the couplings fail to hold.
5. All pneumatic nailers with automatic feed and that operate with over 100 PSI pressure must have a safety device on the muzzle to prevent the nailer from ejecting when not in contact with the work surface. It is wise to have this feature on all nailers.
6. Never point a nailer or stapler at anyone. When carrying them, point them toward the floor.
7. Never use pneumatic hoses for hoisting anything.

8. Use a dryer and filter to prevent moisture and dirt from entering the tool.
9. Be sure hose and fittings are in good condition and securely fastened before opening the air-line valve.
10. Never exceed the manufacturer's recommended pressure for tools.
11. Wear proper personal protection when using pneumatic tools.
12. When work is completed, shut the air supply off and then run the tool to drain the line before disconnecting.

SPRAYER SAFETY

1. Do not exceed air pressure recommended by manufacturer. A blowup could occur.
2. When spraying, wear respiration protection and work in a well ventilated area only.
3. Never spray near ignition hazards.
4. Do not point the sprayer at anyone.

HYDRAULIC POWER TOOL SAFETY

1. Hydraulic fluid must be fire resistant and approved by the United States Bureau of Mines.
2. Never exceed the manufacturer's recommended safe operating pressure for hoses, pipes, fitting, filters, and controls.
3. Never touch a stream of hydraulic fluid from a leak. The fluid under pressure can cause serious injuries.

POWDER-ACTUATED TOOL SAFETY

1. Powder-actuated tools must be checked out and tested before loading each day. If not in good working order, they must not be used until repaired.
2. Do not load powder-actuated tools until just before using them.
3. Never point them at anyone, whether loaded or not.
4. Hearing and eye protection must be worn along with any other necessary personal protection.
5. Never allow hands or fingers in front of the open barrel end.
6. Never leave the tool unattended when using it, even if it is unloaded. Return it to its case and put away where unauthorized personnel cannot get it.
7. Leave protective guards in place.
8. There must be a safety device to prevent firing in case the tool is

dropped or while it is being loaded and unloaded.

9. There must be a safety device that prevents firing if the muzzle is tilted over eight degrees.
10. There must be a safety device that prevents the tool from firing unless the muzzle is pressed against the material surface.
11. Use low velocity piston type tools whenever possible.
12. Only those trained and qualified by an authorized dealer or distributor should be allowed to use powder-actuated tools.
13. Do not use powder-actuated tools where there is a combustion or explosion hazard.

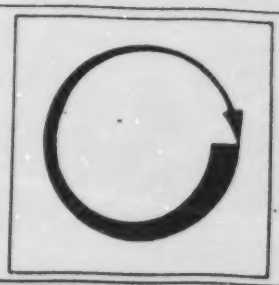
FASTENER (STUD GUN) SAFETY

1. Do not drive fasteners into very hard or brittle materials such as:
   a. Cast iron
   b. Glazed tile
   c. Surfaced hardened steel
   d. Glass block
   e. Face brick
   f. Hollow tile

COMPRESSOR SAFETY - Even though compressors are actually powered by electric motors or gasoline engines, they will be covered here because of their direct use with pneumatic tools.

1. Air storage tanks on compressors must be approved by the American Society of Mechanical Engineers (A.S.M.E.) and have this approval permanently stamped into them.
2. Drain the water out of the storage tanks at least daily, to prevent rust through and weak points.
3. Compressed air storage tanks must be equipped with a working safety relief valve to prevent exploding.
4. Keep the relief valve and pressure gauge in good working condition.

Assignment



Select any two of the following three assignments to complete instead of taking the Self Assessment and Post Assessment exams.

1. List, step-by-step all of the safety practices that you perform when operating at least two of the electrical, pneumatic, hydraulic, or powder-actuated tools which you use in your work.

2. Write a short report for your instructor, citing at least eight power tool violations at your job site, and explain what can be done to correct the violations.

3. Have your instructor show you or demonstrate to you at least five power tools which are in unsafe condition or unsafe use, and you point out the faults.

Self Assessment

Select the answer which best completes the statement. Write the letter of that answer in the blank to the left of the statement.

1. ____ All electric tools must have:
   a. cover guards
   b. grounding wires
   c. guard covers
   d. receptacles

2. ____ Circular saws should be used to cut:
   a. in the forward motion only
   b. in the backward motion only
   c. in non-ferrous woods
   d. crooked cuts

3. ____ One of the requirements for using compressed air for cleaning is that:
   a. pressure is less than 15 pounds per square foot
   b. pressure is less than 30 pounds per square foot
   c. pressure is less than 15 pounds per square inch
   d. pressure is less than 30 pounds per square inch

4. ____ Regarding pneumatic tool use, hose couplings should be:
   a. fitted with a safety connection
   b. subjected to no more than 15 pounds per square inch
   c. made of 1/2-inch hose
   d. fitted by compressed air

5. ____ When carrying a pneumatic nailer or stapler, always:
   a. point it toward the ceiling
   b. point it toward the floor
   c. point it toward your leg
   d. point it toward a wall

6. ____ If the operator exceeds the air pressure recommended by the manufacturer:
   a. a blowup could occur
   b. ignition could occur
   c. paint droplets will condense
   d. the nozzle could get plugged up

7. ____ Hydraulic fluid must be:
   a. fire resistant
   b. filter resistant
   c. stored in sub-freezing containers
   d. streak-proof

8. ____ Powder-actuated tools should be equipped with a safety device to prevent discharge:
   a. unless the muzzle is pressed against material
   b. at all times
   c. until the tool is dropped
   d. which is a low velocity piston

9. ____ Fasteners should not be driven into:
   a. extremely hard or brittle materials
   b. concrete
   c. wood
   d. particle board

10. ____ Air storage tanks on compressors must be approved by:
   a. American Society of Mechanical Engineers
   b. American Society of Mining Engineers
   c. American Society of Compressor Engineers
   d. American Society of Pressure Engineers

Self Assessment Answers

1. b
2. a
3. d
4. a
5. b
6. a
7. a
8. a
9. a
10. a

Post Assessment

Select the answer which best completes the statement. Write the letter for that answer in the blank at the left of each statement.

1. ____ With which of the following tools would you likely find coolant being used?
   a. circular saw
   b. reciprocating saw
   c. pneumatic stapler
   d. power hack saw

2. ____ Compressed air can be used for cleaning only if the pressure is less than:
   a. 30 pounds per square inch (PSI)
   b. 3 PSI
   c. 60 PSI
   d. 15 PSI

3. ____ When you're finished using a pneumatic tool, you should:
   a. disconnect the air line, then shut the air supply off
   b. shut the air supply off, then disconnect the line
   c. disconnect the air line, then allow it to drain
   d. allow the line to build up pressure until the next job

4. ____ Any pneumatic hose over 1/2" in diameter should have a safety valve that reduces pressure if the hose fails. The safety valve should be located at:
   a. the source
   b. the tip
   c. the coupling
   d. the dryer

5. ____ In operating a portable circular saw, the saw blade should clear the stock by:
   a. 2-3 inches
   b. 1/4 inch
   c. 1/8 inch or less
   d. no more than 1/2 inch

6. ____ A portable circular saw must have a fixed guard over the upper half of the blade and:
   a. a fixed guard over the bottom half of the blade
   b. a portable guard over the bottom half of the blade
   c. a working movable guard over the bottom half of the blade
   d. a flexible guard over the bottom half of the blade

7. ____ Starting the saw and allowing it to come to full speed before cutting will prevent:
   a. overloading
   b. buckling
   c. burrs
   d. blade tension

8. ____ Couplings between hoses must have:
   a. safety valves
   b. safety harnesses
   c. safety connections
   d. safety tensions

9. ____ Hydraulic fluid must be:
   a. warmed before use
   b. purplish in color
   c. fire resistant
   d. used in powder-actuated tools

10. ____ Fasteners can be driven into:
   a. cast iron
   b. glass block
   c. both of the above
   d. none of the above

Instructor Post Assessment Answers

1. d
2. d
3. b
4. a
5. c
6. c
7. a
8. c
9. c
10. d

6.4

FIRE SAFETY

Goal:

The apprentice will be able to describe fire safety practices.

Performance Indicators:

1. Describe fire behavior.
2. Describe the elements of combustion.
3. Describe fire hazards.

Information

Approximately 8,800 people died as a result of fires in the United States during 1976. On account of recent changes in the method of estimation, this total is down sharply from the approximately 12,000 annual fire fatalities estimated by the National Fire Protection Association. The principal reason for this substantial decrease is a major reduction in the number of motor vehicle fire deaths included in the estimate.

Of the 8,800 estimated total United States fire deaths for 1976, approximately 6,200 or 70 percent are estimated to be residential. On account of the revisions in the method of calculating national death statistics, the proportion of fire deaths that are residential has risen substantially from previous estimates and place new emphasis on the relative severity of the residential fire death problem.

FIRE BEHAVIOR SCIENCE

Fire is a chemical reaction known as combustion. It is frequently defined as the rapid oxidation of combustible material accompanied by a release of energy in the form of heat and light.

BASIC COMPONENTS OF BURNING

For many years, the three-sized figure of the fire triangle has adequately been used to explain and describe the combustion and extinguishing theory (Fig. 2-1) Oxygen, heat, and fuel in proper proportions create a fire, and if any one of the three elements is removed, a fire cannot exist. Recently, a new theory has been developed to explain combustion and extinguishment further. Those who developed this theory made a transition from the plain geometric triangular figure, which we recognize as the fire triangle, to a four-sided geometric figure, a tetrahedron (Fig. 2-2), which resembles a pyramid. One of the four sides serves as the base and represents the chemical chain reaction. The three standing sides represent heat, fuel, and oxygen. The removal of one or more of the four sides will make the tetrahedron incomplete and result in estinguishment of the fire.

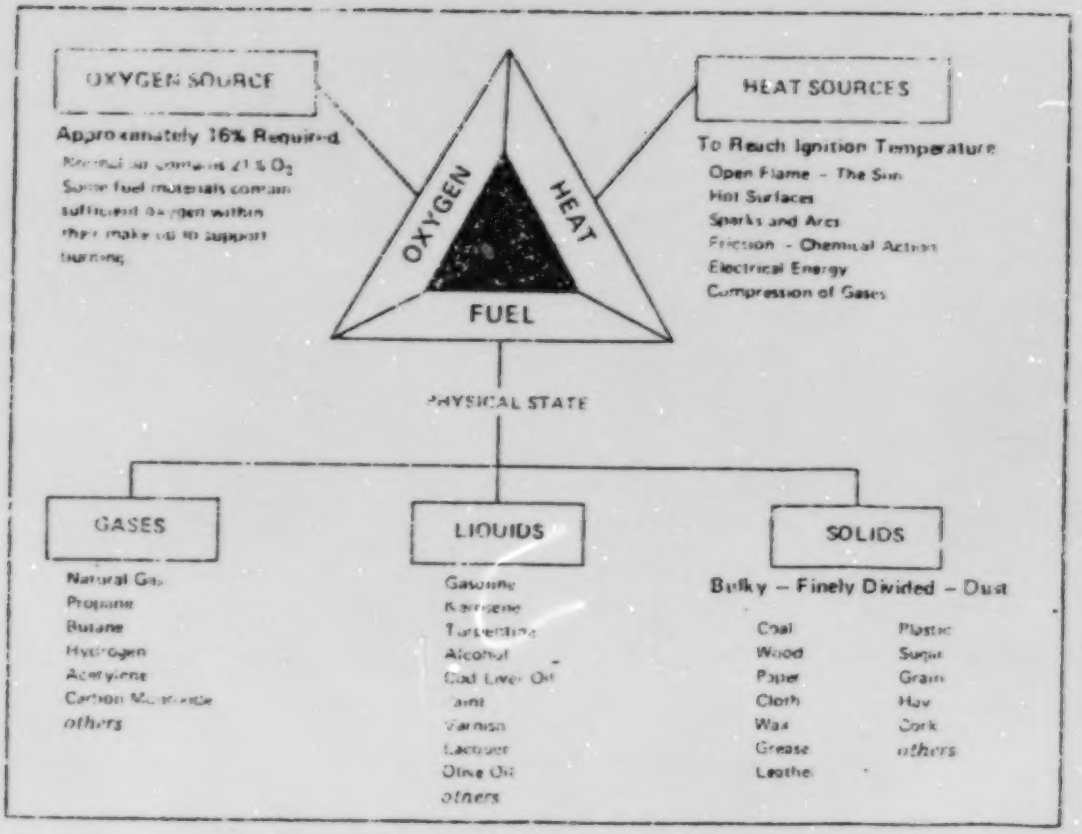


Figure 2-1 The "fire triangle" was used to explain the three components necessary for burning.

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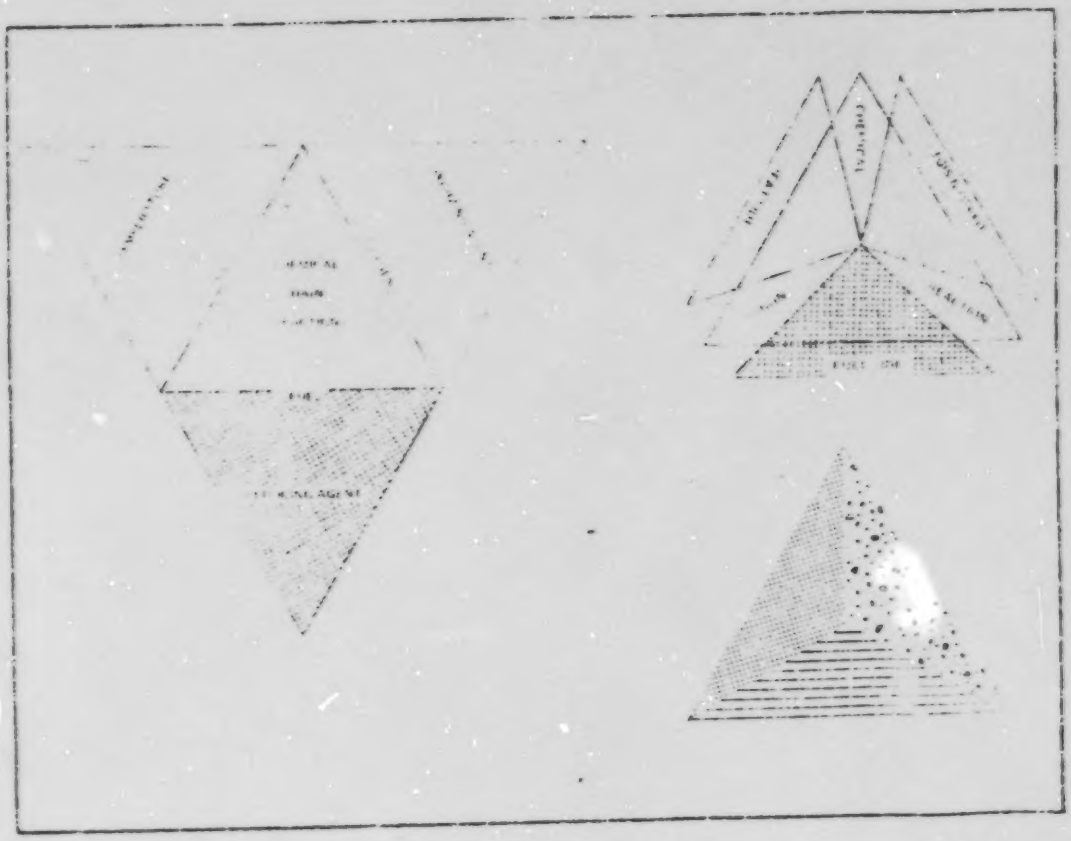

Figure 2-2 The "fire tetrahedron", a four-sided solid, was suggested to include the chemical chain reaction as another component necessary for burning. The components would then form a pyramid.

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FUEL

The fuel segment of both the fire triangle and tetrahedron is defined as "any material that can be oxidized." The term "reducing agent" has reference to a fuel's ability to reduce an oxidizing agent.

OXYGEN (Oxidizing Agent)

The term "oxidizing agent" helps explain how some materials, such as sodium nitrate and potassium chlorate, which release their own oxygen under certain conditions, can burn in an oxygen-free atmosphere.

HEAT (Temperature)

Heat and temprature are closely related and in some cases inseparable. Heat is a type of energy in disorder while temperature is a measure of the degree of that disorder.

CHEMICAL CHAIN REACTION

The vapors of gases which are distilled during the burning process of materia are carried into the flame. These vapors contain atoms and molecules which have not yet been changed and they have an electrical charge which either attracts or repels other particles (Fig. 2-3).

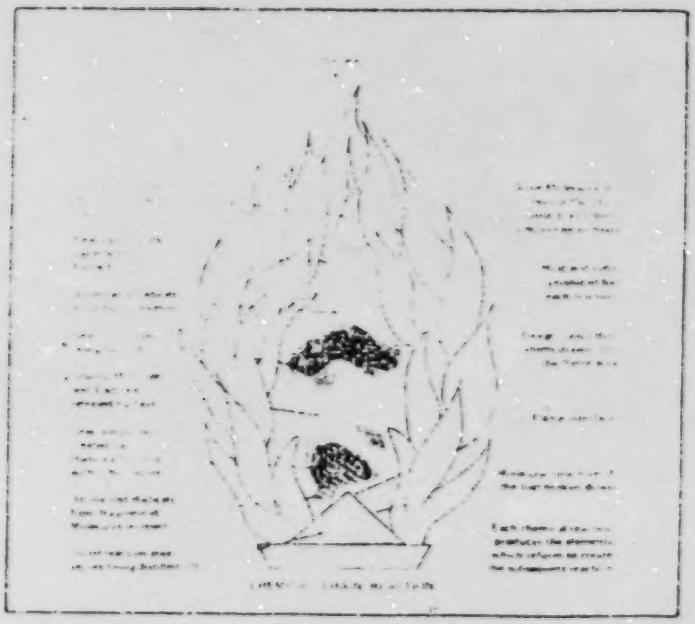

Figure 2-3 Actions during burning which are associated with the chemical chain reaction.

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The area between the flame and the fuel is called the "flame interface", a place where very little burning takes place. Oxygen is drawn into the flame area from the interface throughout its uppermost regions. Here the molecular structure of the material is broken down and the released atoms combine with other radicals to form new compounds which are again broken down by the heat. Neither this description nor the reactions depicted in Fig. 2-3 are a step-by-step process, because these reactions occur simultaneously in varying degrees.

PRODUCTS OF COMBUSTION

When a fuel burns it undergoes chemical change and there are four products of combustion: (1) fire gases; (2) flame; (3) heat; and (4) smoke.

FIRE GASES

The term "fire gases" refers to the vaporized products of combustion. The more common combustible materials contain carbon which, when burned, forms carbon dioxide and carbon monoxide. The principal factors which determine the fire gases that are formed by burning are the chemical composition of the fuel, the percent of oxygen present for combustion, and the temperature of the fire. The carbon in most fuels can be burned to complete combustion under controlled conditions. This condition requires the proper mixture of fuel vapors and oxygen being regulated to the extent that most of the gas produced is carbon dioxide. A good example of complete combustion is found with the common fuel methane (a natural gas) and is diagramed as follows and illustrated in Fig. 2-4.

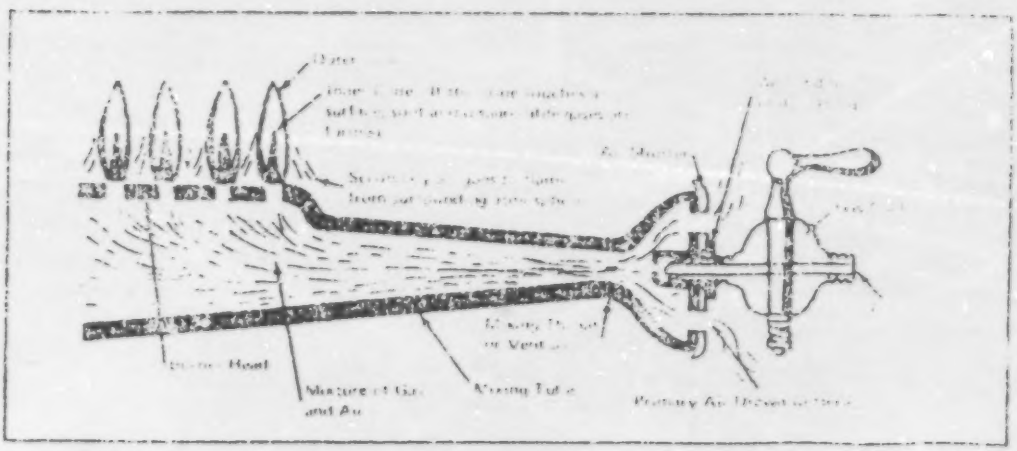

Figure 2-4 Complete combustion of methane occurs when air (O_2) and the fuel are mixed properly.

Under most burning conditions, however, the oxygen concentration is never adequate for complete combustion; consequently, only a part of the carbon is oxidized. This situation is particularly true with carbon fuels other than methane such as wood, cloth, paper, and hydrocarbons. When only a part of the carbon is oxidized, carbon monoxide (C) is formed instead of carbon dioxide (CO_2). While carbon monoxide gas is not the most toxic of fire gases, it ranks first in the cause of fire deaths because it is always one of the most abundant. When two or more gases or vapors are present, their total effect is usually greater than the sum of the factors taken separately. Carbon monoxide (CO) is to unstable and has such an affinity (combining power) for oxygen that it will combine with or rob almost any other oxygen-bearing substance of its oxygen to form CO_2. When carbon monoxide is heated to approximately 1,200 degrees in the presence of oxygen, it will burn to produce carbon dioxide gas. Carbon monoxide gas is colorless, odorless, tasteless, and slightly lighter than air. It may also be produced by slow oxidation. It may be found in sewers, caves, wells and mines in addition to automobile exhaust smoke, stoves, and furnaces.

Hydrogen sulfide (H_2S) is a fire gas which may be formed during fires involving organic material containing sulfur, such as hair, wool, meat and hides. It is a colorless gas with a strong odor similar to rotten eggs and is highly toxic. It is heavier than air and will ignite when heated to 500 degrees F. Nitrous fumes or oxides of nitrogen are also common fire gases and are very poisonous.

FLAME

Flame is the visible luminous (light) body of a burning gas which becomes hotter and less luminous when it is mixed with increased amounts of oxygen. This loss of luminosity is due to a more complete combustion of the carbon. For this reason, flame is considered to be a product of combustion. However, heat, smoke and gas can develop in certain types of smoldering fires without evidence of flame.

HEAT

Heat is a form of energy which is measured in degrees of temperature to signify its intensity. In this sense, heat is that product of combustion which is responsible for the spread of fire. In a physiological sense, it is the direct cause of burns and other forms of injury. In addition to burns, heat-related injuries include dehydration, heat exhaustion, and injury to the respiratory tract. Heat, along with oxygen depletion and carbon monoxide formation are

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regarded as the primary hazards in fires.

SMOKE

Smoke is a visible product of incomplete combustion. Smoke ordinarily encountered at a fire consists of a mixture of oxygen, nitrogen, carbon dioxide, some carbon monoxide, finely divided particles of soot and carbon, and a miscellaneous assortment of products which have been released from the material involved. In a burning structure, smoke builds up gradually and continuously reduces visability until ventilation is accomplished. Lack of visibility causes disorientation which can trap persons in a smoke-filled building.

Self Assessment

Determine the correct word(s) for each statement and fill in the blanks.

1. The three sides of the fire triangle are _____, _____, and _____.

2. More recently a geometric figure known as a fire tetrahedron which forms a pyramid brings into use a fourth component necessary for burning which is _____.

3. Complete combustion produces: _____, _____, _____, and _____ _____.

4. Carbon monoxide is the most toxic of fire gases. True ___ False ___

5. Hydrogen sulfide is heavier than air. True ___ False ___

Self Assessment Answers

1. oxygen, heat, fuel
2. chemical chain reaction
3. flame, heat, smoke, five gases
4. True
5. True

Post Assessment

Choose the answer which best fits the question. Write the letter of the answer on the line in front of the question or fill in the blank with your answer.

1. ____ Based on statistics, how many people could you expect to die as a result of fires in the U.S. this year?

   a. 20,000
   b. 10,000 or so
   c. 850
   d. far more than 20,000

2. What are the three ingredients of any fire?

   a. _____
   b. _____
   c. _____

3. ____ Which of the following fuels is an example of a fuel which creates its own oxygen while burning?

   a. wood or textiles
   b. green wood only
   c. tetrahedron
   d. sodium nitrate

4. ____ What are the four products of fuel combustion?

   a. _____
   b. _____
   c. _____
   d. _____

5. ____ Which gas is the most abundantly produced by a fire?

   a. carbon dioxide (CO_2)
   b. carbon monoxide (CO)
   c. hydrogen sulfide (H_2S)
   d. all of them are found in similar quantities

6. ____ Which of the following occurs when oxygen to a fire in increased?

   a. flame becomes hotter
   b. flame becomes cooler but is more visible
   c. more smoke is produced
   d. more hydrogen sulfide is produced

7. ___ Which of the following is a heat-related injury?

a. boils
b. dehydration
c. hardening of the arteries
d. softening of the arteries

8. ___ Statistically, what percentage of deaths due to fire are residential in nature?

a. 77%
b. 88%
c. 82%
d. 70%

9. ___ The term "fire gases" refers to

a. the vaporized produces of combustion
b. the vaporized products of smoke
c. the vaporized products of atom release
d. the vaporized products of oxidizing agents

10. ___ Which of the following is probably <u>not</u> a part of smoke?

a. carbon dioxide
b. titanium crystals
c. oxygen
d. soot

Instructor Post Assessment Answers

1. b
2. a. fuel, b. heat, c. oxygen
3. d
4. a. smoke, b. fire gases, c. heat, d. flame
5. b
6. a
7. b
8. d
9. a
10. b

6.5

HYGIENE SAFETY

Goal:

The apprentice will be able to describe occupational health hazards and their prevention.

Performance Indicators:

1. Describe noise hazards to human health.
2. Describe dust, vapor and fume hazards.
3. Describe chemical hazards.

Study Guide

For successful completion of this module:

1. Familiarize yourself with the objectives on the cover sheet of this module.
2. Study the Information section.
3. Take the Self Assessment.
4. Take the Post Assessment.

Information

An industrial hygienist is a person who has been trained in recognizing, evaluating, and controlling environmental factors. The hygienists concern themselves with the chemical, physical, biological, or stress factors that may cause illness, impaired health, or significant physical discomfort to employees.

Health hazards frequently result in employee over-exposure to toxic materials. There are many toxic materials, some of which you are probably quite familiar with, such as chlorine gas or carbon monoxide.

When an employee becomes over-exposed to toxic materials, his or her health can be affected either internally (vital internal organs) or externally (skin, sense organs). Therefore health hazards result from both INTERNAL and EXTERNAL exposure to toxic materials.

INTERNAL EXPOSURE results in damage to internal organs from harmful or toxic materials entering the body in three ways.

1. By breathing contaminants into the respiratory tract or lungs, such as dust, fumes, vapors, mists, or gases.
2. By swallowing contaminants with saliva, water, or food into the digestive tract.
3. By absorption through the skin.

Many substances, such as TNT, leaded gasoline and hydrogen cyanide can produce internal poisoning by direct contact with the skin. If there are wounds such as open cuts, scratches, or breaks in the skin, absorption is still easier.

The other type of health hazard, EXTERNAL EXPOSURE, can be defined as a contact with the skin or sense organs by harmful elements, or simply too much contact with an ordinarily harmless element. Effects of external exposure can vary quite widely --from skin rashes to severe burns. Even noise can be considered an external health

hazard.

NOISE

Exposure to noise affects one of our senses; the sense of hearing. There are five senses: sight, hearing, smell, taste, and touch. Any one of these senses can be affected by external over-exposure to toxic materials, or physical agents.

Until three decades ago, the effect of noise hazards on workers was not regarded as significant by some employers. As more information was gathered, it became evident that many employees were suffering from acute hearing losses due to the noise levels in their work area. To effectively combat the problems of excess noise in your work area, you should understand some of the basic concepts of sound and noise levels.

The noise level of any operation is measured in terms of DECIBELS (dB). A decibel is the measurement of the intensity of a sound. Different sounds have different decibel levels. For example, the intensity of a soft whisper is about 30 dB, normal speech is about 73 dB, and a jet airplane gives off an intensity level of about 160 dB. If you have ever been near a jet airplane when the engines were on, you will probably remember how loud and possibly painful the noise was.

One important point to remember, with regard to sound, is that a hearing loss usually occurs only after a worker has been exposed to a noise level over a period of time. For example, we listed the intensity level of a jet airplane as 160 dB. If you were at an airport and were near the airplane for a short time, you wouldn't experience a permanent hearing loss. But if you had to work near airplanes all day, and didn't wear ear protection, you would eventually experience a hearing loss.

Following is a list of exposure levels a worker can tolerate for a certain number of hours per day over a long period of time.

Maximum Hours of Exposure Per Day	Sound Level Measured in dBA
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/2 or less	115

As you have probably noticed in the sound exposure levels, the notation dBA is used. We have already explained what decibel (dB) means. The "A" stands for a scale on a sound level meter, which approximates the range of a person's hearing. Whenever a qualified person measures the noice level in your work area, he or she will use a sound meter.

If excessive noise exists, temporary measures, such as ear plugs or ear muffs, should be instituted immediately, while steps for a permanent solution are being taken. Industrial hygienists or safety and health specialists can help to recommend the best course of action.

Not only does noise affect the ability to hear, it also affects the body itself. Noise can cause changes in the size of blood vessels, restricting the flow of blood, making the heart work faster. Noise also affects the brain, causing blood vessels to enlarge and produce headaches. Other body organs, such as the kidneys, also are affected by noise.

Excessive noise affects the rest of your body and therefore can also be an internal exposure.

Noise can also stimulate an individual to a nervous peak. Momentary lapses of efficiency result which lead to errors in judgment. This may be reflected in a reduced quality of work and an increased number of accidents.

There are many permanently harmful consequences for employees who are over-exposed to toxic materials. The following table indicates the results of over-exposure to some specific toxic materials or hazardous physical agents.

Sense Organ	Exposure to:	Effect of Extreme Overexposure
Eyes (Sight)	Butyl Alcohol	Loss of Sight
Ears (Sound)	Excessive Noise Levels	Loss of Hearing
Nose (Smell)	Acetic Anhydride	Loss of Sense of Smell
Mouth (Taste)	Chromium	Loss of Sense of Taste
Skin (Touch)	Phenol	Extreme Dermatitis

External exposure to certain chemicals removes the skin's protective oils and makes it more susceptible to injury. An example of a chemical that will do this is acetone.

There are many ways that materials and chemicals can affect the body. The first specific type we will talk about is called exposure to AIRBORNE CONTAMINANTS. They are measured in Threshold Limit Values (TLV). TLV refers to airborne concentrations of substances, and represents limits under which nearly all employees may be exposed without adverse effects. Threshold limit values are stated in terms of time weighted concentrations for an 8-hour workday and 40=hour workweek.

Following is a brief description of each of the categories of airborne contaminants which can be commonly found at work sites.

DUSTS are airborne particles generated mechanically from operations such as drilling, cutting, blasting, crushing, and grinding. Dust particles are measured in microns (microns are about 1/25,000 of an inch in size). Most dust averages between 1/2 to 3/4 of a micron. Dust particles therefore can not be seen by the human eye. They can affect a person's skin, eyes and lungs.

Another airborne contaminant is FUME. Fumes are solid particles that are produced by condensation of vapor usually accompanied by chemical changes. Examples are welding, burning, and decomposition by heat. The most common fumes are caused by the oxidation of a metal. Fumes are usually smaller than dust and range generally below 1 micron; they cannot be seen by the naked eye either.

Another airborne contaminant is MIST. Mists are particles of liquids or mixtures of liquids and solids. The size of a mist depends upon the process by which it is made. An example is the chromium plating process.

Another airborne contaminant is GAS. Gas is a low density material that can expand and contract when it comes into contact with different ranges of temperature and pressure. A gas can be changed to a liquid or solid by proper changes of both temperature and pressure.

An example of this type of airborne contaminant would be a gasoline engine propelled forklift that puts out carbon monoxide in the form of a poisonous gas. Employees should take extreme care when they operate a gasoline propelled vehicle in a

closed space.

The last airborne contaminant we will discuss is called VAPOR. Vapors are gaseous forms that normally are in the solid or liquid state at room temperature. Most vapors can be changed back to a solid or liquid state by increasing the pressure OR decreasing the temperature. This differentiates vapors from gases since gases change to a solid or liquid by changing both temperature AND pressure.

Most hazardous materials can be classified by the way they affect the body. Airborne contaminants, in addition to those already mentioned, may include the following: 1) IRRITANT materials that attack the lungs, 2) ASPHYXIANT materials that combine with the blood to prevent the normal transfer of oxygen to the tissues, 3) ANESTHETIC and NARCOTIC materials that cause sleepiness and nausea, 4) SYSTEMIC poisons that attack the vital organs of the body such as the liver and kidneys.

Short of covering your entire body and breathing from a self-contained unit, there is virtually no way to protect yourself from the many gases, fumes, etc. which are found at many work sites. Fortunately, the body can accept many of them for short periods with little negative effect. Ventilation is the most effective way to deal with most of them, circulating air which replinishes contaminated air with fresh air. Gloves, proper clothing and face shields may be necessary in some instances. Respirators, or other artificial breathing devices, should be used only as a last resort.

Self Assessment

From the four possible answers below each statement, select the one that correctly completes the statement. Place the letter for that answer in the blank to the left of the statement.

1. ____ How many hours per day could employees work in an area that was measured to be 100 dBA?
   a. one hour
   b. two hours
   c. three hours
   d. four hours

2. ____ If vapor, mist, gas, fumes, or dust in your work area irritates your EYES, the effect would be called an _____ exposure.
   a. internal
   b. illegal
   c. external
   d. isotonic

3. ____ A material that causes a worker to pass out because of lack of oxygen would be:
   a. irritant
   b. asphyxiant
   c. external
   d. systemic

4. ____ What would the effect of dust on an employee be called?
   a. negligible
   b. internal exposure
   c. external exposure
   d. both b and c

5. ____ Noise may cause:
   a. temporary loss of vision
   b. temporary loss of hearing
   c. both a and b
   d. loss of hearing, stress, loss of concentration

6. ____ Noise has been regarded as a health and safety hazard for:
   a. about 300 years
   b. about 30 years
   c. about 3 years
   d. about 3,000 years

7. ____ Which of the following is clearly an example of internal exposure?
   a. breathing contaminants
   b. swallowing contaminants
   c. absorbing contaminants
   d. all of the above

8. ____ An industrial hygienist is a person who can recognize, evaluate, and control:
   a. decibels
   b. chlorine gas
   c. environmental factors
   d. intangible factors

Self Assessment Answers

1. b
2. c
3. b
4. d
5. d
6. b
7. d
8. c

Post Assessment

Select the answer which best completes each statement. Write the letter for that answer in the blank to the left of the statement.

1. ____ Noise can affect:
   a. the ability to hear
   b. the body itself
   c. both of the above
   d. airborne contaminants

2. ____ Which of the following is an example of a vapor?
   a. the smell of soup heating on a stove
   b. a small particle of liquid from the air in a chrome plating factory
   c. a TLV
   d. those small particles in the air after blasting a hillside

3. ____ Which of the following is not an airborne contaminant?
   a. gas
   b. sunlight
   c. dust
   d. fume

4. ____ A material which affects the heart is called:
   a. an irritant
   b. an asphyxiant
   c. a narcotic
   d. a systemic poison

5. ____ The best way to protect yourself from airborne contaminants is:
   a. wear a cotton hood
   b. ventilate the area
   c. wear a pressurized suit
   d. wear gloves and a shield

6. ____ The main difference between dusts and mists is:
   a. one can kill you and the other can't
   b. the size
   c. no difference
   d. one may be a particle comprised of liquids

7. ____ Exposure to toxic materials can result in:
   a. internal damage
   b. internal or external damage
   c. internal and external damage
   d. external damage

8. ____ Swallowing contaminated material is an example of:
   a. internal exposure
   b. stomach cramps
   c. external exposure
   d. both internal and external exposure

9. ____ TLV refers to:
   a. thematic limit values
   b. concentrations of substances and the time which the body can withstand them
   c. only airborne particles of dust, mist or vapor
   d. none of the above

10. ____ If your skin absorbs a toxic material like gasoline, you run the risk of:
   a. internal injuries
   b. toxic hydrosis
   c. industrial hygiene
   d. loss of hearing

Instructor Post Assessment Answers

1. c
2. a
3. b
4. d
5. c
6. d
7. c
8. a
9. b
10. a

6.6

SAFETY AND ELECTRICITY

Goal:

The apprentice will be able to describe safety practices in working with electrical circuits.

Performance Indicators:

1. Describe circuit protection.
2. Describe grounds.
3. Describe electrical hazards.

BASIC ELECTRONICS

Safety and Electricity
EL-BE-07

Objectives

Given:

A list of questions about power distribution, ground, fire, and shock hazards.

The student will:

Answer the questions with an 80 percent accuracy.

Directions

Obtain the following:

This package and a pencil.

Learning Activities

_____ Review Key Word meanings.

_____ Read Information Sheets.

_____ Do Self-Tests.

_____ Do Final Test.

_____ Obtain Final Evaluation.

Key Words

Arcing: A condition in which current jumps across an open circuit.

Transformer: An electrical device that uses magnetism to reduce or increase the voltage in an AC circuit.

Power Meter: A device which is used by an electric company to measure the amount of power a customer uses.

Distribution Panel: See load center.

Load Center: The metal box that houses the fuses or circuit breakers and the terminal connectors for the various branch circuits in a building.

Fuse: A device that has an overload protection element that will melt in two to break the path for current.

Fuses

When the element melts in two, it will open the circuit like a switch that has been turned off.

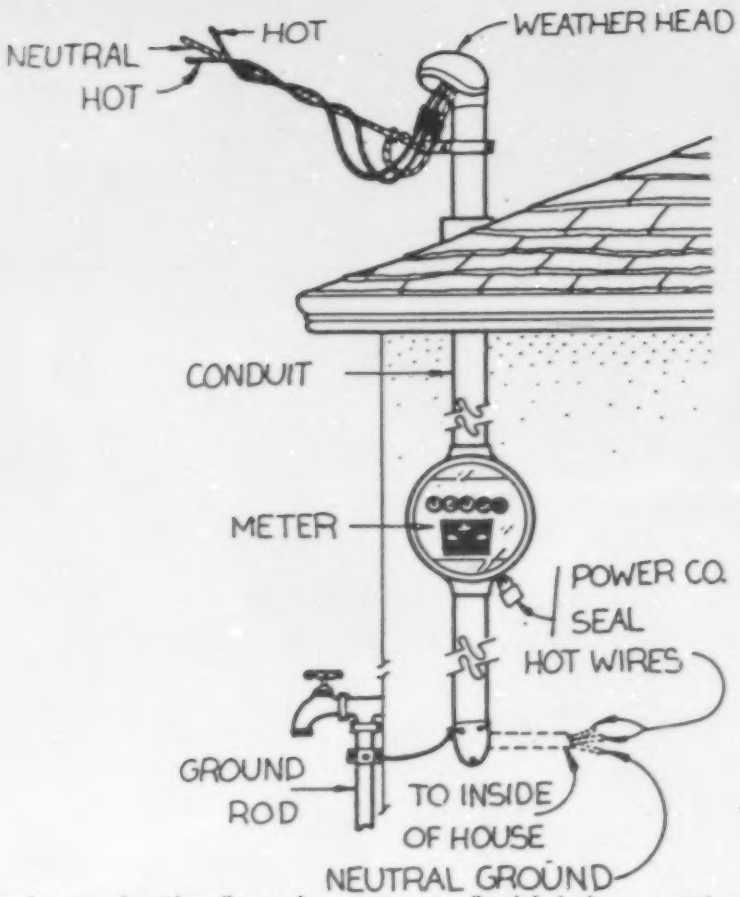
Circuit Breaker: A device that breaks the circuit when above a certain current, similar to the fuse. However, the circuit breaker is designed to be re-used, unlike the fuse which is unusable after the element has melted in two.

Ground:

1. The side of the power supply that is connected to a metal chassis so all of the points in the circuit can be connectd to the chassis, instead of wires from each going back to that side of the power supply for a return path for current.

2. The earth's surface in an electrical power distribution system.

3. The reference voltage path that is the common return of several parts of a circuit. You may consider all the points where the same ground symbol is used to be connected.



SERVICE ENTRANCE

At the house is the "service entrance" which has a meter that measures the amount of power you use. Your monthly electric bill is based on the readings of this meter. There is also a grounding connection at the service entrance or somewhere nearby. A ground is a return path for current back to the source of power. It can be any conductor of electricity. Examples are a wire, a metal surface such as an appliance case, or the earth itself (i.e., dirt, especially wet dirt or water, especially salt water).

Once inside the house, there is a distribution panel that divides the power into branch circuits. This panel also provides overload protection in the form of fuses or circuit breakers.

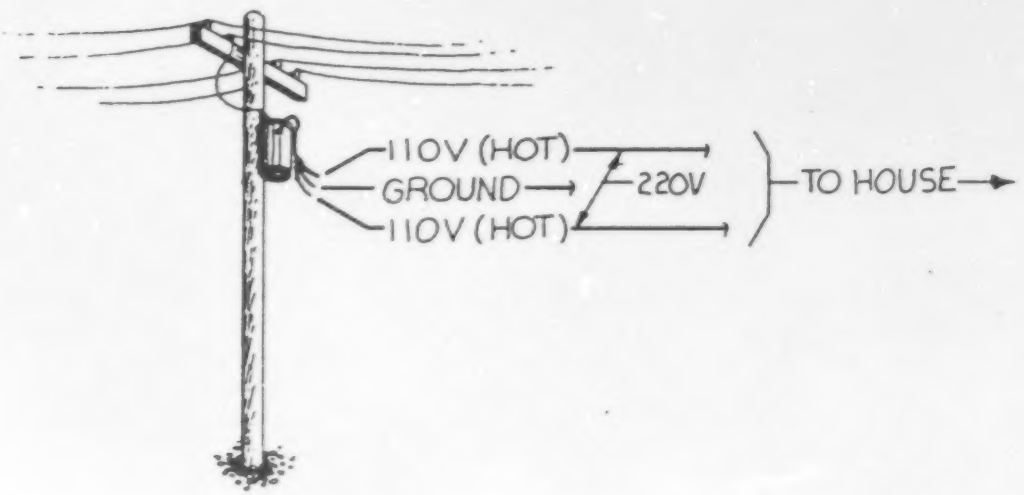
Information Sheet

Electricity is a very versatile form of power. Its energy can be used to warm us, transport us from one place to the other, and do work for us. It is the force for our primary means of communication--telephones, TV, and radio. By providing the energy for electronic calculators and data processing equipment, it speeds and expands all of technology. Developments based on electricity continue to grow at a rapid pace.

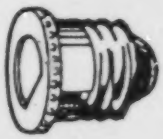
As with any form of energy that can be used for our benefit, there are also some hazards. This package will discuss some of those hazards and how to deal with them.

First, let's become familiar with the most widely used form of electricity with which you come in contact--the electrical circuits found in your own home or lab.

Electrical Circuits From The Street To Your Home

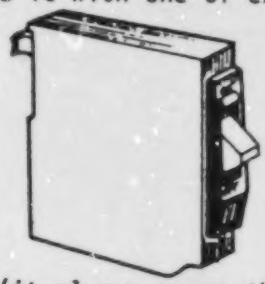


Fuses are rated in amperes (the base unit for current). The fuse has an element that will melt in two if the current in the circuit exceeds its rated value. When a fuse "blows," it's very important to replace it with one of exactly the same amperage.



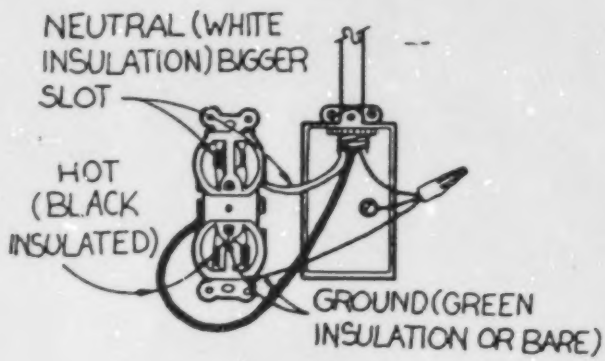
FUSE

CIRCUIT BREAKER



Circuit breakers are more common today than fuses (it always seems that when you are out of fuses of a certain amperage, that's the size that blows). If a circuit breaker overloads and switches off, all you need to do is switch it back on. (Many may first need to be reset by switching to OFF position, then turning on again.) Also, there is no danger in replacing a circuit breaker with one of the incorrect amperage or size as can occur with fuses.

The wires that supply the various circuits in the house are of a certain size to provide safe conduction depending on current draw, voltage, and distance to load from distribution panel. There are strict local codes which electricians must follow to pass inspection of new wiring installations or modifications.



Outlet or Receptacle Circuit

Lighting Circuit

When you are working with circuits, DO NOT DEPEND ON THE WIRE COLORS TO BE PROPERLY HOOKED UP!!! It is not uncommon for the switch in a light circuit to open the neutral wire. This means that there is 110 volts at the fixture ALL the time. If you turn off the light switch to replace the bulb and you are grounded some way (i.e., touching the earth surface or a metal surface connected to earth), you may just "light up" yourself.

GROUND

All matter in the universe has an electrical balance of positive and negative charges. It is natural for these charges to seek a neutral balance. When there is a difference in charge, either positive or negative, there is an electrical potential between the two points. Electrical potential occurs where there is different level of voltage between two points. When engineers design circuits and raw schematics, either one of these two points is usually selected

as the ground or common reference point. A reference point is a place to which to refer in the circuit that is common to several voltage points. The voltage level of the planet earth is the reference point that power companies use when transmitting electric power to your home or school. This reference point is logically referred to as ground.

Other smaller systems, like a car or TV, may use the frame or chassis as the reference point. Thus, the chassis is referred to as ground reference or just ground.

Symbols for Ground

The ground in some electronic systems may be at a different level than earth. It is advisable to measure the voltage between the ground of an electronic piece of equipment and earth ground. When testing equipment with a grounded test instrument, it is advisable to use isolation transformers for safety purposes.

Carbon dioxide (CO_2) extinguishers are the best type to use on electrical fires. The CO_2 extinguisher looks like other extinguishers and are available in many sizes and will say CO_2 on the label. Carbon dioxide is noninjurious in small quantities, noncorrosive, a nonconductor of electricity, extremely rapid acting and will not lose effectiveness with age. The CO_2 smothers a fire with carbon dioxide snow and gas. After smothering the fire, it will dry off and won't leave any residue on equipment.

Carbon tetrachloride is nonconductive and will smother electrical fires but gives off a poisonous gas.

There are other types of extinguishers that may be used on electrical fires, but they are not as good as CO_2.

A.B.C. dry chemical extinguishers will put out the fire but leaves a big mess on any salvageable equipment.

New types of fire extinguishers are arriving on the market regularly, and there may be some other good extinguishers for electrical fires, but, so far, the CO_2 is your best choice.

Shock:

Electricity follows the easiest path to a complete circuit or "easiest path to ground." An opening in the neutral wire or even a connection that gives some resistance is very hazardous. Your body is a conductor. Your skin has resistance which varies with the amount of moisture on the surface. Lie detectors measure the change in resistance due to the change in moisture on the skin.

Pure water is not a good conductor but the salts and particles in the water can provide an electrical pathway. So any moisture or dampness will increase danger of electrical shock.

If you get a shock, the amount of current is more important than the amount of voltage. Voltage in your house circuits is 110 V (lights and outlets) and 220 V (dryer, range and water heater).

People have been electrocuted with as little as 42 volts.

DANGER! LOW VOLTAGE

Current in your home is in circuits that are fused not to exceed 15 amps or 20 amps for outlets at 110 volts and 40 to 60 amps for your electric range, dryer, and water heater at 220 volts.

Death can be caused by currents of 1/40 of one amp!!!

DANGER! LOW CURRENT!

Do not be afraid of electricity, but use care when working with it. When working on possible "live" circuits, do not use both hands (keep one in your pocket or behind you). The most dangerous shocks are those which go across your heart.

Your muscles are controlled by electrical signals carried by nerves from your brain. When you get an electrical shock, your muscles are activated by the electricity. If you are grasping the source of current with your hands, they may clamp onto the source so you cannot let go. This is very dangerous, especially if your heart, which is also a muscle, is in the path of the current.

If you get in this situation where you are clamped onto a current source, try to let your legs go limp so your body weight can pull you clear.

If you see someone else in this situation, do not grab the person or you may become part of the circuit. You should, if you can, do the following things:

1. Unplug or turn off power.

2. Use a wooden broom handle, rope, blanket or any nonconductive material to pry or pull the victim clear.

3. Kick or push victim loose with your foot, or clasp your hands together and knock the victim clear. A flying tackle may be a good method to knock the victim loose also, depending on the situation.

It is not within the scope of this program to train you for the first aid for reviving a victim of shock. But is is good practice when working around electricity to know such things as artificial respiration and cardiopulminary resuscitation (C.P.R.). Training in these is available and can be learned in one-day classes.

Self-Test No. 1

Match Up:

1.	Pure water	A.	Junction point for incoming power and outgoing branch circuits.
2.	Meter	B.	Needs heat, fuel, and oxygen.
3.	Load center	C.	Best extinguisher for electrical fire.
4.	Fuse/breaker	D.	Voltage capable of causing death.
5.	Ground	E.	A poor conductor of electricity.
6.	Fire	F.	Weakest link in electrical circuit.
7.	Current	G.	Current capable of causing death.
8.	CO_2	H.	Device to keep track of how much power you use.
9.	42 volts	I.	The electrical "killer."
10.	1/40 amp	J.	Chosen reference point in an electrical system.

Self-Test No. 2

1. Match the color to the proper wire and outlet terminal, A, B, or C.

Color	Outlet Letter
Neutral 1 _____	4 _____
Hot 2 _____	5 _____
Ground 3 _____	6 _____

Final Test

Fill in the answers from the list below.

1. Your electric bill is based on the amount of power you use, measured by the _____.

2. At the load center, the individual circuits are protected by _____ or _____ _____.

3.

   1. _____
   2. _____
   3. _____

4. The best type of fire extinguisher to use on an electrical fire is a _____.

5. The part of electricity that causes death is _____.

6. The two main hazards when working around electricity are _____ and _____.

a. fuse	d. current	g. ground	j. hot
b. neutral	e. meter	h. shock	
c. fire	f. CO_2	i. circuit breaker	

Answers

Self Test #1

1 - F
2 - H
3 - A
4 - F
5 - J
6 - B
7 - I
8 - C
9 - D
10 - G

Self Test #2

1 - white
2 - black
3 - green
4 - A
5 - B
6 - C